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| ORIGINAL

Academics knowledge about tooth bleaching: technical and ethical issues

Conhecimento de acadêmicos acerca do clareamento dental: questões técnicas e éticas

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ABSTRACT

Objective: The aim of this study was to evaluate the level of knowledge of UFES dental students about home bleaching treatment. **Methods**: As a methodology, a descriptive and cross-sectional study was carried out through the application of practice to 109 students, containing questions about home tooth whitening, technical care and possible complications of the treatment. Data were tabulated and submitted to descriptive statistics. **Results**: Of the total number of students, 88.99% said they knew the factors that limit or contraindicate the bleaching treatment, 16.51% of students recognize hydrogen peroxide as a possible inducer of oral cancer, 30.27% of the students had their teeth whitened inside the University, 44.03% had their teeth whitened outside the University without professional supervision. In addition, 56.88% believe anamnesis and clinical examination are necessary before the bleaching treatment. **Conclusion**: It is concluded that students have limited knowledge about certain points of at-home tooth whitening. Students know the risk factors of bleaching treatment, except regarding hydrogen peroxide being a possible inducer of oral cancer. It can be inferred that academics highlight the importance of associating the clinical examination with the patient's anamnesis before performing the bleaching treatment. Most students have had their teeth whitened outside the University, which calls attention to reinforce knowledge about the ethical issues of the profession.

Indexing terms: Students, dental. Teaching. Tooth bleaching.

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RESUMO

***Objetivo**: O objetivo deste estudo foi avaliar o nível de conhecimento dos acadêmicos de odontologia da UFES sobre o tratamento clareador caseiro. **Métodos**: Como metodologia, foi realizado um estudo descritivo e transversal por meio da aplicação de questionário a 109 estudantes contendo perguntas sobre o clareamento dental caseiro, cuidados técnicos e possíveis riscos do tratamento. Os dados foram tabulados e submetudos à estatística descritiva. **Resultados**: Do total de estudantes, 88,99% disse conhecer os fatores que limitam ou contraindicam o tratamento clareador; 16,51% dos estudantes reconhecem o peróxido de hidrogênio como possível indutor de câncer bucal; 30,27% dos estudantes realizaram o clareamento dental dentro da Universidade, 44,03% realizaram o clareamento dental fora da Universidade sem supervisão profissional. Além disso, 56,88% acreditam que são necessários anamnese e exame clínico antes de realizar o tratamento clareador. **Conclusão**: Conclui-se que os alunos têm conhecimento limitado sobre determinados pontos do clareamento dental caseiro. Os estudantes conhecem os fatores de risco do tratamento clareador, exceto a respeito do peróxido de hidrogênio ser um possível indutor de câncer bucal. Pode-se inferir que os acadêmicos relevam a importância da associação do exame clínico com a anamnese do paciente antes de se realizar o tratamento clareador. A maioria dos estudantes tem realizado o clareamento dental fora da Universidade, o que chama atenção para reforçar o conhecimento sobre as questões éticas da profissão.*

Termos de indexação: *Estudantes de Odontologia. Ensino. Clareamento dental.*

INTRODUCTION

Dental aesthetics have been gaining increasing prominence in modern Dentistry [1,2]. Consequently, the technique of home-based external bleaching has become highly popular due to its simplified practice, based on self-application by the patient, and its relatively low cost, with or without association with other dental aesthetics techniques [2]. However, any recommendation for treatment and its prescription must be grounded in etiology and diagnosis to establish an appropriate treatment plan, assessing the absolute need for intervention or, conversely, clinical resolution with other prophylactic procedures [3].

Dental bleaching is indicated for teeth with color alterations relative to normality, distributed uniformly across the dental crown, pigmentation from tetracyclines grades I and II, tobacco pigmentation, physiological changes due to age, chromatic changes due to trauma, mild fluorosis, and teeth with atretic canals or dystrophic pulp calcification [4,5]. However, patients presenting with periodontal disease, caries, restorations with marginal deficiencies, and/or dentin exposure, for example, should undergo treatment prior to any whitening procedure [6]. It is known that the bleaching technique can lead to side effects such as gingival irritation, tooth roughness, and demineralization [7] when performed inadvertently or without proper professional supervision. An important side effect of whitening treatment is dental hypersensitivity, which can occur in 15% to 78% of cases [5,8].

Various whitening techniques can present different levels of risk and side effects for patients, depending on the techniques used and the regularity of controls performed by the dentist [3,5]. Therefore, patients should be informed about the risks associated with dental bleaching and instructed on identifying adverse occurrences so that they can seek professional help when necessary [7].

For home bleaching, hydrogen peroxide gel is used in lower concentrations, ranging from 3% to 9.5%, for periods commonly varying from half an hour to two hours per application, over approximately four to six weeks, with periodic visits to the dentist [9,10]. Alternatively, carbamide peroxide gel can be used in concentrations ranging from 10% to 22% [10], which is considered more conservative and effective for treating darkened and stained anterior teeth [2]. Ten percent of carbamide peroxide degrades into about 7% urea and 3% hydrogen peroxide, releasing a smaller amount of hydrogen peroxide, which helps maintain a neutral pH by releasing urea, reducing the possibility of dental mineral damage [11]. However, hydrogen peroxide is reported to act as a promoter or co-carcinogen in oral chemical carcinogenesis, potentiating effects initially induced by other carcinogenic initiating agents, such as ethanol [12,13], and may cause damage even to gastrointestinal mucosa [12,14]. Therefore, despite all the care taken by the patient and professional during home whitening, hydrogen peroxide may overflow beyond the tray, potentially spreading to the oral mucosa and oropharynx, making ingestion unavoidable and contacting gastrointestinal mucosa, leading to undesirable consequences [12,14].

For all these reasons, it is essential to be familiar with the patient's medical and dental history by conducting a detailed medical history and thorough clinical examination to minimize any side effects of aesthetic bleaching treatment

[6], regardless of whether it is a home or office-based technique. In this context, dental students must have adequate knowledge and awareness of dental aesthetics, as this can help them better understand the needs and expectations of their patients and formulate better treatment plans [1].

Although discussions about the side effects of dental whitening are addressed during classes in the Dentistry program at the Federal University of Espírito Santo (UFES), some students focus only on the aesthetic aspect, performing home bleaching treatments on themselves or friends and family without proper consideration of the indications, limitations, and contraindications of the technique. Therefore, this questionnaire-based research aimed to gather data about this scenario.

Thus, the primary objective of this study was to assess the level of knowledge among dental students at UFES regarding whitening treatment, especially home-based bleaching. Secondary objectives included evaluating knowledge about care and risks associated with whitening treatment and whitening agents, as well as assessing knowledge regarding the necessity of obtaining a patient's profile through comprehensive medical history and clinical examination before whitening treatment.

METHODS

The research project was submitted to the Ethics Committee for Research Involving Human Subjects (CEP/CCS/UFES) and initiated with the authorization of the research protocol (CAAE 49298015.9.0000.5060). This is a documentary, descriptive, and cross-sectional study in which the level of knowledge was assessed using an instrument for the analysis of anonymous questionnaires. These questionnaires were administered to students enrolled in the Dentistry Program at UFES, starting from the sixth semester up to the tenth semester, provided that they have already received instruction on the subject matter. The questionnaire consisted of 16 objective questions encompassing technical care and potential risks associated with whitening treatment. These risks included dentin sensitivity, the role of hydrogen peroxide as a co-carcinogen, decreased dentin adhesion to resin restorative materials, and knowledge of the concentration of whitening agents. The questionnaire was administered by the academic researcher, who was appropriately calibrated and trained to explain the research and address any questions regarding questionnaire completion. An informed consent form (ICF) was provided to each voluntary research participant and signed. Responses were tabulated in Microsoft Excel spreadsheets and subjected to descriptive statistics. To calculate the research sample size, the following formula was used:

$$n = \frac{N.Z^2.p.(1-p)}{Z^2.p.(1-p) + e^2.(N-1)}$$

Where:

n - calculated sample

N – population of 150 students

Z - standardized normal variable associated with the confidence level (95%)

p - true probability of the event

e - sampling error

Based on the sample calculation, the total sample size consisted of 109 students. The data collected from the questionnaire were recorded in tabular form and organized based on percentage evaluation.

RESULTS

Out of the 109 students who responded to the questionnaire, 100% confirmed having received instruction on dental bleaching. When asked if the students were aware of the limiting factors and contraindications of bleaching

treatment, the majority (88.99%) responded affirmatively (table 1). Furthermore, another question posed to the students pertained to the potential induction of oral cancer by hydrogen peroxide. Only 16.51% of the students indicated knowledge of this subject (table 1). The remaining 83.49% responded that hydrogen peroxide is not an inducer of oral cancer and that they were unaware of this topic. When questioned about whether hydrogen peroxide, in the home technique, could be an irritant to the mucous membranes of the oropharynx and gastrointestinal tract, 83.48% confirmed that it is.

Table 1. Absolute and relative frequencies of responses related to knowledge about the risk factors of tooth bleaching.

	Number of students per academic term					Total	%
	6º (12)	7º (28)	8º (29)	9º (22)	10º (18)		
Students who are familiar with the factors that indicate or limit bleaching Hydrogen peroxide as an inducer of cancer	12 (100%)	23 (82.14%)	25 (86.21%)	19 (86.36%)	18 (100%)	97	88.99
Hydrogen peroxide as an irritant to the oropharyngeal and gastrointestinal mucosa	6 (50%)	1 (3.57%)	4 (13.79%)	2 (9.09%)	5 (27.78%)	18	16.51
Hydrogen peroxide as an irritant to the oropharyngeal and gastrointestinal mucosa.	12 (100%)	20 (71.43%)	26 (89.66%)	19 (86.36%)	14 (77.78%)	91	83.48

Slightly more than half of the students (56.88%) consider anamnesis and clinical examination necessary before commencing dental bleaching (table 2). Concerning the practice of home dental bleaching within the University under the supervision of a professor, the 6th semester had the fewest cases (n=2) of home dental bleaching. Conversely, when evaluating the practice of home dental bleaching outside the university without the supervision of a dentist and/or professor, 50% of 6th-semester students and 61.12% of 10th-semester students reported having undergone the treatment. The 7th semester had the lowest rate of home bleaching outside the university (25%). An inconsistency was observed regarding the practice of home bleaching within and outside the university, as the 6th semester, which practiced home dental bleaching the least within the University, was the second highest in terms of practicing it outside the University without professional supervision (table 2). Only 11.92% of the students believe that the home technique is suitable for all patients (table 2).

Table 2. Absolute and relative frequencies of responses regarding the implementation of whitening treatment within and outside the University.

	Number of students per academic term					Total	%
	6º (12)	7º (28)	8º (29)	9º (22)	10º (18)		
Necessary anamnesis and clinical examination before dental bleaching.	12 (100%)	28 (100%)	0 (0%)	22 (100%)	0 (0%)	62	56.88
Students who underwent dental bleaching within the University, under the supervision of the professor.	2 (16.67%)	10 (35.71%)	10 (34.48%)	7 (31.82%)	4 (22.22%)	33	30.27
Students who underwent dental bleaching outside the University, without professional supervision.	6 (50%)	7 (25%)	14 (48.28%)	10 (45.45%)	11 (61.11%)	48	44.03
Students who believe that the home technique is suitable for all patients.	1 (8.33%)	2 (7.14%)	1 (3.45%)	7 (31.82%)	2 (11.11%)	13	11.92

When questioned about the time that should be expected for the replacement of adhesive restorations after dental bleaching, it was observed that 88.99% of the students responded that one should wait between 7-15 days (table 3).

Table 3. Absolute and relative frequencies of responses regarding the replacement of restorations before and after the whitening treatment.

	Number of students per academic term					Total	%
	6º (12)	7º (28)	8º (29)	9º (22)	10º (18)		
Consider sensitivity a risk.	12 (100%)	26 (92.86%)	27 (93.10%)	20 (90.91%)	17 (94.44%)	102	93.57
They believe that the restoration should be replaced before bleaching due to failure of marginal adaptation.	3 (25%)	6 (21.43%)	5 (17.24%)	3 (13.64%)	3 (16.67%)	20	18.34
7-15 day waiting period after teeth whitening to perform adhesive restorative procedures	11 (91.67%)	26 (92.86%)	23 (79.31%)	20 (90.91%)	17 (94.44%)	97	88.99

Note: the replacement of restorations before and after the whitening treatment.

Similarly, there was an inquiry about the circumstances requiring the replacement of restorations before commencing dental bleaching, whether due to marginal adaptation issues or color concerns. Few students (18.34%) responded, indicating the need for restoration replacements before the whitening treatment only in cases of marginal adaptation failure (table 3). The majority, 81.66%, of participating students responded that restoration replacement for color-related reasons is recommended only after bleaching.

When asked if dentin sensitivity could be considered a risk for undergoing whitening treatment, 93.57% responded affirmatively to this question (table 3).

Table 4 shows that the majority of students are aware of the concentrations of hydrogen peroxide gels (4-10%) and carbamide peroxide (6-16%) recommended for home dental bleaching.

Table 4. Absolute and relative frequencies of responses regarding the use of carbamide peroxide and hydrogen peroxide in tooth bleaching.

	Number of students per academic term					Total	%
	6º (12)	7º (28)	8º (29)	9º (22)	10º (18)		
Hydrogen Peroxide as the Most Efficient and Effective Agent	9 (75%)	17 (60.71%)	17 (58.62%)	17 (77.27%)	6 (33.33%)	66	60.55
Carbamide Peroxide as a Biologically Safe Agent	10 (83.33%)	20 (71.43%)	21 (72.41%)	20 (90.91%)	11 (61.11%)	82	75.22
Concentrations of 6% to 16% for Home bleaching Using Carbamide Peroxide	12 (100%)	28 (100%)	27 (93.10%)	22 (100%)	17 (94.44%)	106	97.24
Concentrations of 4% to 10% for Home bleaching Using Hydrogen Peroxide	12 (100%)	27 (96.43%)	29 (100%)	21 (95.45%)	18 (100%)	107	98.16

DISCUSSION

All participants in the research declared that they had received instruction on dental bleaching. However, many demonstrated limited knowledge about some adverse effects and technical aspects of this type of aesthetic treatment.

The majority of interviewed students (83.49%) responded that hydrogen peroxide is not an inducer of oral cancer, with some being unaware of the subject. In contrast, 83.48% were aware of the bleaching agent's potential to irritate the mucous membranes of the oropharynx and gastrointestinal tract. Studies have shown that irritation of the oral mucosa is the most common adverse event associated with tooth bleaching, along with dental hypersensitivity. This irritation can lead to ulcerations in the soft oral tissues, including the gingival tissue, and within the gastrointestinal tract. Additionally, hydrogen peroxide is a known cocarcinogen and has mutagenic potential when combined with other factors, potentially causing DNA damage to normal epithelial cells. The reactive oxygen resulting from the oxidation reaction of bleaching gels can rapidly diffuse through the mineralized tissues of the tooth, promoting oxidative stress, generating a more intense response with thinner enamel and dentin, reduced cell viability, cell death, or stimulation of cellular differentiation.

Dahn and Pallesen [8] demonstrated that hydrogen peroxide can act as a tumor promoter in hamsters, and multiple exposures to hydrogen peroxide resulted in effects on gastric mucosa, reduced weight gain, and alterations in blood chemistry in rats. The consensus is that the prescription of bleaching therapies should be controlled by clinicians to minimize risks.

In this study, despite the majority of students believing that the at-home technique is not suitable for all patients, there was a significant percentage of students who practiced bleaching without professional supervision and without conducting anamnesis and clinical examination. Even though scientific evidence exists regarding the detrimental effects of bleaching agents and their byproducts, only slightly more than half of the students (56.88%) considered it necessary to perform anamnesis and clinical examination before starting dental bleaching. Among these students, 100% of those in the 8th and 10th semesters believed that both anamnesis and clinical examination were unnecessary before bleaching. This observation highlights students' lack of knowledge regarding the precautions that need to be taken before undertaking a bleaching treatment.

Anamnesis and clinical examination are essential for diagnosing the etiology of color changes and identifying potential contraindications for bleaching to reduce the risk of complications during and after treatment. Bleaching is contraindicated for patients with thermal sensitivity, teeth with pulp involvement, erosive/abrasive lesions, abfraction, and patients with a wide pulp chamber, as well as for individuals with pre-cancerous conditions (smokers, alcoholics) and lesions in the oral mucosa [12].

A paradoxical situation was observed concerning the practice of at-home dental bleaching within and outside the university. The periods (6th and 10th) with the least practice of dental bleaching within the university were the ones that practiced it the most outside the university, without any professional supervision. However, despite having fewer opportunities to perform the bleaching technique in the university clinics, nothing justifies their eagerness to clinically apply the aesthetic treatment outside the academic realm and without the proper supervision of a professional/teacher. The practice of dental procedures without the supervision of a dentist and/or teacher is not considered an internship but rather the illegal practice of the profession, as stated in Resolution No. 63/2005 of the Federal Council of Dentistry [15].

As all the student participants in the research have already been exposed to courses in Ethics and Bioethics, as well as Clinical Restorative Dentistry, it is evident that they are aware of the ethical violations within the profession, in addition to the technical and biological aspects of dental bleaching. Therefore, they should respect and adhere to these ethical principles. Nevertheless, some students show resistance to learning when it comes to ethics and morality, with their values being shaped throughout their lives, primarily within the family context, revealing their limitations and demonstrating that they are not adequately prepared to address the ethical dilemmas they encounter, as observed in other studies [16].

In addition to theoretical knowledge and clinical skills, future dentists need to be well-informed about other important aspects of professional practice, such as their civil responsibility, which encompasses civil, criminal, ethical, and administrative obligations [16], applying the concepts learned since their undergraduate education. The Code of Dental Ethics [15] places significant emphasis on dental documentation, stating that it is mandatory to create and maintain legible and up-to-date patient records, stored in a designated physical or digital archive. Zanin et al. [17] emphasized that

the patient record is the most crucial preventive document that a professional must maintain, including comprehensive patient information: medical history, clinical charts, dental and periodontal clinical examinations, intra and extra-oral physical examinations, radiological examinations, and other complementary exams, recommendations and prescriptions, estimates, treatment plans, study models, and informed consent, all duly signed by the patient. Thus, only with access to all this data can a more accurate diagnosis, treatment planning, and treatment plan be established for each patient.

When a student neglects the proper maintenance of patient records and the performance of a thorough medical history and clinical examination before what they perceive as a "simple" at-home teeth whitening treatment, they compound ethical violations in their conduct. Providing treatment to friends and family members, outside the academic context and without the necessary qualifications, for purely aesthetic purposes, is a reprehensible behavior that must be discouraged, not only to prevent biological harm but also to avoid subsequent legal issues.

In a case study conducted in the legal sphere, Cerri et al. [18] mentioned that when dental records were not presented or were inadequately maintained, in 87% of cases, the patient prevailed over the defending dentist. According to those authors, in terms of the absence of examinations, the courts have taken the stance that it is the professional's duty to exercise caution and demand examinations that can reduce the risk of accidents during treatment, as the lack of prior examinations can lead the dentist to commit gross errors of imprudence, negligence, and incompetence. In other words, all information must be clear and adequately substantiated, including information about the risks of treatment failures, as well as potential complications and procedure limitations. As seen, the principles of ethics and bioethics, as well as the diagnosis and treatment plan, should be scientifically grounded and conducted safely to achieve the expected results [18] and benefit the patient. According to Cohen & Segre [19], being an ethical professional requires more than just knowledge of the Code of Ethics for one's profession; this would constitute merely moralistic behavior. Therefore, to effect change, it is not enough to simply introduce a Bioethics course into the curriculum; students must genuinely learn as a whole, not only for the acquisition of technical skills. There is a need to educate ethical professionals and responsible citizens who possess a critical understanding of reality and the competence to act in a manner that is dedicated to the well-being of humanity.

Regarding other adverse effects, such as painful sensitivity, when students were asked if this sensitivity could be considered a risk in performing teeth whitening treatment, 93.57% responded affirmatively, reflecting their knowledge in this matter. Scientific evidence has demonstrated a high frequency of reports of dental sensitivity during bleaching [8,20,21], which is caused by the harmful effect of hydrogen peroxide on pulp tissues, as well as by the stimulation of neural receptors [4]. Although studies report that the dental sensitivity induced by bleaching is transient, not lasting beyond two weeks [20] after treatment, it is of utmost importance to attempt to alleviate this discomfort by employing desensitizing protocols [4,21,22] aimed at providing comfort and safety for the patient.

When asked whether existing restorations in the patient should be replaced due to marginal failure, a change in color, or both situations before undergoing whitening treatment, only 18.34% of students indicated the need to replace them due to marginal failure. This perspective does not consider that the lack of a proper seal of the restoration can facilitate the penetration of the whitening agent into the dentin and towards the pulp, potentially causing deleterious effects [23].

In addition to the biological aspect, tooth whitening agents negatively affect the adhesion of resin restorative materials to the tooth. When resin composite restorations are performed immediately after the completion of bleaching, a decrease in adhesive strength is observed [6]. This reduction has been attributed to the presence of residual oxygen within the dental structure, which hinders the polymerization of monomers [24,25], as well as the loss of protein and mineral content from dental tissues due to whitening [26]. Thus, to improve the adhesive strength of previously whitened teeth, it is recommended to wait for one to two weeks to achieve satisfactory adhesion [6,27], a fact duly known by 88.99% of the interviewed students.

The majority of students, 98.16% and 97.24%, respectively, demonstrated a proper understanding of the recommended ideal concentrations of hydrogen peroxide and carbamide peroxide gels for at-home bleaching. It is widely

documented in the literature that low concentrations of carbamide peroxide gels (up to 16%) and hydrogen peroxide gels (up to 10%) are used for at-home bleaching [10].

More than half of the questioned students (75.22%) confirmed the knowledge already described in the literature that, despite the lower concentration, when comparing carbamide peroxide and hydrogen peroxide, the former is considered safer because its degradation releases a small amount of hydrogen peroxide, generates carbon dioxide and ammonia, contributing to an increase in pH levels and causing fewer adverse effects on hard dental tissues [11], as well as less sensitivity and less gum irritation [28]. However, caution is still necessary in the use of carbamide peroxide, as shown in the study by Soares et al. [29]. In this study, carbamide peroxide whitening agent at concentrations of 10% and 16%, both at a neutral pH, significantly reduced calcium and phosphorus content, and increased the roughness and porosity of the dental surface, with these effects being more intense when the higher concentration (16%) was used. The authors concluded that an increase in gel concentration leads to more problems without any final aesthetic benefit, only reducing the treatment time but associated with more intense adverse effects. These conclusions were similar to those of the study by Abouassi et al. [30], which reported that the influence of the whitening procedure on enamel surface roughness and microhardness depends on the concentration of its active ingredients, being higher for 10% hydrogen peroxide and similar for 3.5% hydrogen peroxide and 10% carbamide peroxide.

The considerations presented here reinforce the fact that whitening products should be referred to as medications rather than cosmetics and should not be used indiscriminately by any individual without the proper diagnosis, prescription, and professional supervision.

CONCLUSION

Through this study, it can be concluded that students have limited knowledge regarding at-home dental bleaching. The students are aware of the risk factors associated with whitening treatment, except when it comes to the topic of hydrogen peroxide as a potential inducer and coadjutant of oral cancer. It can be inferred, therefore, that the students recognize the importance of combining clinical examination with patient history-taking before performing whitening treatment. Consequently, there is a need to emphasize the importance of further in-depth study and exploration of the topic of dental bleaching among students in general.

It is also noteworthy that the majority of students have been conducting dental whitening treatments outside the university environment, which underscores the importance of reinforcing their knowledge regarding the ethical aspects of the profession.

Collaborators

MD Flor-Ribeiro, writing, review, updating, submission. NS Rodrigues, writing, data collection, initial data analysis. FLA Castro and DC Barcellos, data analysis, review. FB Pazinatto, project design, final data analysis, review.

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